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Gonadal and hematopoietic neoplasms were found in soft shell clams (Mya arenaria) which were collected from two oil spill sites in Maine.

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Gonadal and Hematopoietic Neoplasms in *Mya arenaria*

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The reproductive tract of the soft shell clam, *Mya arenaria*, goes through a number of morphologic changes during its reproductive cycle (Coe and Turner, 1938). While studying several thousand animals from all coastal areas of the United States, many variations were encountered in the "normal" pattern of gonadal development. Animals, collected from two areas in the State of Maine which are known to have been contaminated by oil, exhibited abnormal cell development.

At Long Cove, Searsport, Maine, there was an oil spill in 1971 of #2 fuel oil and the jet fuel, JP-5 (Mayo, et al.[1], 1972). There has been a chronic seepage of oil since then. Microscopic examination of *Mya arenaria* collected from this site during the last 4 years revealed neoplastic growth possibly originating from germ cells in the gonadal tissues of both male and female clams. Neoplastic lesions in the gonadal tissue of the soft shell clams contained cells with mitotic figures, pleomorphic mononucleated cells, and multinucleated giant cells. Many nuclei were lobed and irregular containing two or more prominent red-staining nucleoli and were hyperchromatic with clumping of nuclear chromatin.

In animals in which normal tissue

[1]Mayo, D. W., C. G. Cogger, D. J. Donovan, R. A. Gambardella, L. C. Jiang, and J. Quan. 1972. Correlation of spilled oil in the Searsport, Maine, region by gas chromatography. Bowdoin College, Department of Chemistry, Brunswick, Maine. November 1972. Tech. report (unpublished ms.), p. 3.

Figure 1.—Soft shell clam, *Mya arenaria*, collected from the oil spill site, Searsport, Maine. Gonadal tumor. Note extensive invasion by neoplastic cells throughout the body. Arrows point to specific areas of invasion. Key: f = follicles and connective tissue of the gonadal area; b = body wall; d = genital duct; and g = gill.

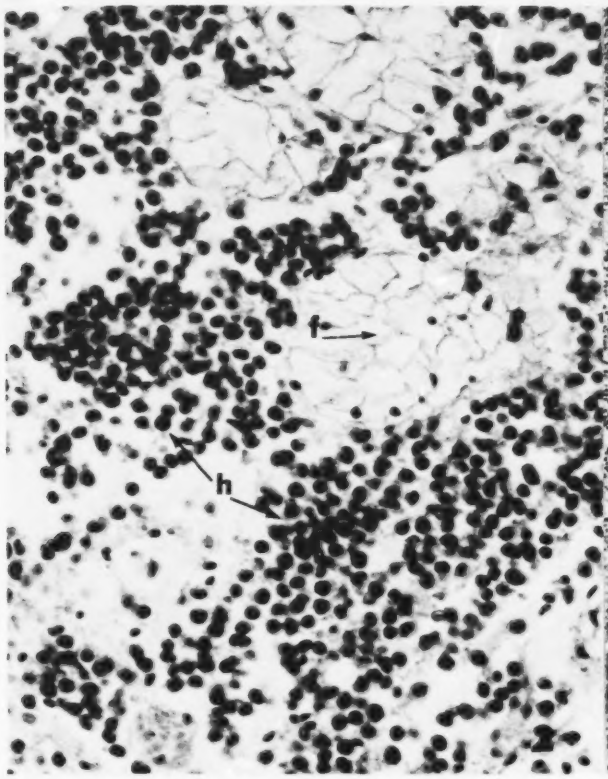

Figure 2.—Soft shell clam, *Mya arenaria*, collected from oil spill site, Harpswell, Maine. Hematopoietic tumor. Neoplastic cells occupy connective tissue areas of the reproductive tract. Arrow h indicates hematopoietic tumor cells. Arrow f indicates gonadal follicles.

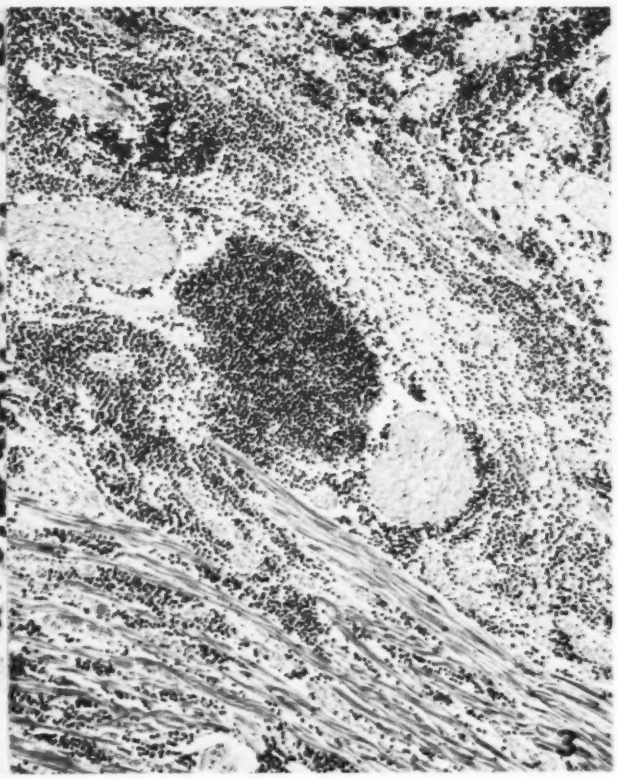

Figure 3.—Soft shell clam, *Mya arenaria*, collected from an oil spill site, Harpswell, Maine. Hematopoietic tumor. Note invasion of neoplastic cells between the muscle bundles of the foot.

structures were still evident, the gonadal characteristics appropriate to the sex of the clam were seen. However, in some instances, the neoplastic development was so extensive that it replaced the normal gonadal tissue, making sexual differentiation by histologic examination difficult or impossible. Some of the soft shells showed invasion of the interfollicular connective tissue of the gonadal area, body wall, efferent blood vessel of the gills, epibranchial chamber, genital and urinary pores, kidney, pericardial wall, heart, and red gland by the neoplastic cells. Eventually the normal architecture of these areas was destroyed (Fig. 1).

At the site of the Naval Reservation tank farm, Freeport, Maine, known as the Brunswick or Harpswell oil spill site, a seepage of jet fuel, JP-4, from the tank area has contaminated adjacent clam flats for several years. Neoplastic growth was observed in soft shell clams collected from this site, but the site of origin and type of tumor was different than that in animals from Long Cove.

These cells probably originated in the mesenchymal cells of the body connective tissues and appear to be of hematopoietic lineage. The cells possess large nuclei which may be pleomorphic or lobed (Fig. 2). Some show numerous and sometimes bizarre mitotic figures. The cytoplasm of these cells may contain fine red granules. There are extensive accumulations of neoplastic cells in the gills, siphon, foot, and in connective tissues throughout the body (Fig. 3).

No tumors similar to those just described have been encountered in animals collected from any other area. At present it is not understood why tumors consisting of morphologically different cell types are encountered in the two areas. The development of tumors does not appear to be associated with any seasonal or cyclic changes. It is more probable that they are the result of a factor or factors in their environment. Very little is known about the hydrocarbon concentration, water, sediment, and water column at these sites, and more importantly, of the reaction of the soft shell clam to the wide variety of hydrocarbons that constitute fuel oils.

LITERATURE CITED

Coe, W. R., and H. J. Turner, Jr. 1938. Development of the gonads and gametes in the soft shell clam (*Mya arenaria*). J. Morphol. 62:91-111.

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